

**§ 25.406. Milestones.**

(a) All conditional permittees of space stations in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) must file the demonstrations required by Section 25.405(d) within one year after the grant of the conditional construction permit or, in the case of conditional permittees of space stations in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) that will provide international service, within sixty days after the State Department has notified the Commission that all applicable treaty obligations of the United States have been satisfied, whichever is later.

(b) Construction of the first space station in a Non-Voice Non-Geostationary Satellite Service (< 1 GHz) system must be commenced within one year after the grant of a nonconditional construction permit, and must be completed within four years after the grant of a nonconditional construction permit.

(c) Conditional permittees of multiple Non-Voice Non-Geostationary Satellite Service (< 1 GHz) space stations must satisfy the requirement of paragraph (b) of this section as to the first space station in their systems, and must commence construction of all remaining space stations required to make the certification called for in Section 25.403(a) within three years after the grant of a nonconditional construction permit.

(d) All space stations authorized for a Non-Voice Non-Geostationary Satellite Service (< 1 GHz) system, except stations authorized as on-ground spares, must be launched and operational within six years after the grant of a nonconditional construction permit.

(e) All permittees of space stations in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) must notify the Commission as each milestone in paragraphs (a) - (d) of this section is met.

**§ 25.407. Frequency Assignment Policies.**

Each Non-Voice Non-Geostationary Satellite Service (< 1 GHz) licensee will be assigned frequencies in the 137-138 MHz, 148-150.05 MHz, [399.9-400.05 MHz,] and/or 400.15-401 MHz bands, subject to its ability to demonstrate compliance with all of the requirements of this subpart, including the demonstration that it will not cause harmful interference to any authorized or licensed Non-Voice Non-Geostationary Satellite Service (< 1 GHz) system, and the demonstration that it will operate compatibly with other authorized users in the assigned frequency bands by complying with the operating conditions specified for Non-Voice Non-Geostationary Satellite Service (< 1 GHz) systems in Section 25.408.

**§ 25.408. Operating Conditions for Systems Operating in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz).**

In order to ensure compatible operations with authorized users in the frequency bands to be utilized for operations in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz), Non-Voice Non-Geostationary Satellite Service (< 1 GHz) systems must operate in accordance with the conditions specified in this section.

(a) Service Limitation. Voice services may not be provided.

(b) Coordination Requirements.

(1) The frequency bands allocated for use by the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) are also authorized for use by agencies of the United States Government. The governmental use of frequencies in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) frequency bands is under the regulatory jurisdiction of the National Telecommunications and Information Administration (NTIA).

(2) The Commission will use its existing procedures for liaison with NTIA to reach agreement with respect to the avoidance of mutually unacceptable interference between Non-Voice Non-Geostationary Satellite Service (< 1 GHz) systems and governmental users under the jurisdiction of NTIA through the frequency assignment and coordination practices established by NTIA and the Interdepartment Radio Advisory Committee (IRAC).

(3) For purposes of the preceding paragraph of this section, the Commission shall coordinate with NTIA with regard to the frequencies to be used by those earth stations of Non-Voice Non-Geostationary Satellite Service (< 1 GHz) systems that are not subject to blanket licensing under Section 25.409, and authorized governmental fixed stations in the Fixed and Mobile services, through the exchange of appropriate systems information. In addition, the Commission shall coordinate with NTIA on the spectrum use that will lead to the avoidance of unacceptable interference between Non-Voice Non-Geostationary Satellite Service (< 1 GHz) system downlink operations and authorized governmental users.

#### **§ 25.409. User Transceivers.**

Individual user transceivers need not be licensed. Service vendors may file blanket applications for transceiver units using FCC Form 493 and specifying the number of units to be covered by the blanket license. FCC Form 430 should be submitted if not already on file in conjunction with other facilities licensed under this subpart. Each applicant for a blanket license under this section shall demonstrate that transceiver operations will not cause harmful interference to other authorized users of the spectrum. This demonstration shall include a showing as to all the technical parameters, including duty cycle and power limits, under which the individual user transceivers will operate.

**§ 25.410. Noncommercial Non-Voice Non-Geostationary Satellite Service (< 1 GHz) Systems.**

The following provisions shall be applicable to noncommercial Non-Voice Non-Geostationary Satellite Service (< 1 GHz) satellite systems. If other provisions of this subpart conflict with this section, the provisions of this section shall apply.

(a) Eligibility. Noncommercial Space stations in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) shall be licensed only: (1) for the provision of international services; (2) on a non-common carrier basis; and (3) to non-profit entities organized under Section 501(c)(3) of the Internal Revenue Code.

(b) Scope of Service. Noncommercial space stations in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) shall be licensed only upon a showing that they will be used primarily to serve health, educational, scientific, disaster relief, or other humanitarian assistance needs of the intended user population. In no event shall a noncommercial space station in the Non-Voice Non-Geostationary Satellite Service (< 1 GHz) be used for the provision of services that are not directly related to the furtherance of the licensee's health, educational, scientific, disaster relief or humanitarian objectives.

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

COPY

In the Matter of )  
)

Establishment of an Advisory )  
Committee to Negotiate Proposed )  
Regulations for Low-Earth Orbit )  
Satellite Services Operating )  
Below 1 GHz )  
)

CC Docket No. 92-76

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AUG 7 - 1992

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

Jointly Filed Supplemental  
Comments of ORBCOMM, STARSYS and VITA

Orbital Communications Corporation ("ORBCOMM"), STARSYS Global Positioning, Inc. ("STARSYS") and Volunteers in Technical Assistance, Inc. ("VITA"), the applicants for the proposed Non-Voice Non-Geostationary Satellite Services operating in low-Earth orbit (collectively the "Applicants"), have continued their discussions concerning their ability to coexist in the spectrum the Commission proposed to allocate to these services.<sup>1/</sup> The ability to develop a sharing program has been complicated by the need to accommodate the known and unknown current users of this band, which include a large number of licensees (some of which operate with high power). It has been difficult to design a sharing plan among the three Applicants that will allow them to

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<sup>1/</sup> See Jointly Filed Comments of the Applicants, May 18, 1992 at p. 5.

operate in this environment, so that some measure of flexibility among the Applicants has necessarily been retained.

The Applicants believe that all three systems can be accommodated within the 137-138 MHz, 148-149.9 MHz and 400.15-401 MHz bands, based on the technical information exchanged among the Applicants and their current understanding of the conditions under which they will be operating.<sup>2/</sup> The Applicants also believe that they will be able to make highly efficient use of all of the spectrum proposed to be allocated by the Commission for these services.

With these Supplemental Comments, the Applicants have formulated a proposal that is intended to resolve the mutual exclusivity that may exist between ORBCOMM and STARSYS, and to enable the Commission to license the Applicants expeditiously, without a formal hearing. The Applicants have no intention to exclude additional entrants from these bands, and note in this regard that their May 18, 1992 Proposed Service Rules for the Non-Voice Non-Geostationary Satellite Services specifically contemplate further entry.

Additional potential spectrum for these services in the 149.9-150.05 MHz and 399.9-400.05 MHz bands was identified by the

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<sup>2/</sup> To the extent that subsequent, actual operating conditions differ from the Applicants' expectations, the Applicants are committed to engaging in good faith negotiations to develop a proposal for an alternative sharing arrangement that will satisfy the needs of all of the licensees. In addition, the frequencies selected from within the bands have been based on preliminary informal discussions with the U.S. government. There may thus be a need for some adjustments depending on the final coordination with the U.S. government.

Commission in the Notice of Proposed Rulemaking in Docket No. ET 91-280,<sup>3/</sup> but the availability of that spectrum is unclear.

Thus, the Applicants' sharing proposals have not utilized those bands, although the Applicants stand prepared to make productive use of that spectrum, and continue to urge the Commission to allocate that spectrum to the Non-Voice Non-Geostationary Satellite Service. An allocation of the 149.9-150.05 MHz band in particular is consistent with the 1992 WARC, and would well serve the public interest by assuring the highest level of availability for the Non-Voice Non-Geostationary Satellite Service.

The Applicants have proposed to share the 137-138 MHz, 148-149.9 MHz and 400.15-401 MHz bands as follows:

148-149.9 MHz

ORBCOMM would be licensed to operate over the entire bandwidth, employing Dynamic Channel Activity Assignment System (DCAAS) frequency division multiple access (FDMA) modulation techniques, for uplink operations. ORBCOMM initially would confine its operations to the portion of the band above 148.905 MHz (the "upper" part of the band) in order to obviate potential interference to the STARSYS operations in this band. ORBCOMM would use the upper part of the band for its DCAAS operation and for its 50 kHz earth station uplink.

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3/ Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum to the Fixed-Satellite Service and to the Mobile-Satellite Service for Low-Earth Orbit Satellites, ET Docket No. 91-280, FCC 91-305, released October 18, 1991.

STARSYS would also be licensed to operate over the entire bandwidth. It would initially use separate 50 kHz and 855 kHz segments of the band between 148 MHz and 148.905 MHz (the "lower" part of the band), with the 855 kHz segment to be used for user terminal uplinks to the STARSYS satellites, and the 50 kHz segment to be used for STARSYS earth station uplinks to the STARSYS satellites. STARSYS transmissions from user terminals will employ code division multiple access (CDMA) modulation techniques. STARSYS transmissions from its earth stations will employ FDMA modulation techniques.

VITA would use 90 kHz in the band for its FDMA uplink transmissions. VITA's 90 kHz segment would be in the upper part of the band, separate from STARSYS' operations, and separate from ORBCOMM's 50 kHz earth station uplink. ORBCOMM's uplink operations will avoid interference with VITA's system in this band by detecting and avoiding VITA's uplink transmissions.

It is not clear that usage of this band by current and future fixed and mobile radio licensees will allow successful operation of the ORBCOMM DCAAS and STARSYS CDMA systems under the previously described initial sharing arrangement. Recognizing this uncertainty, ORBCOMM and STARSYS may share use of the lower and upper parts of the band, respectively, with the other system, depending upon operational experience. If ORBCOMM traffic saturates<sup>4/</sup> the upper part of the band, and if actual operating

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<sup>4/</sup> For these purposes, "saturation" is defined as a documented lack of usable spectrum preventing the affected system from utilizing in-orbit resources to provide a commercially acceptable grade of service in the average weekday busy hour.



conditions are such that ORBCOMM's DCAAS system can make use of additional channels in the lower part of the band without causing harmful interference to STARSYS and VITA, then ORBCOMM will also operate in the lower part of the band subject to conditions to be negotiated with STARSYS and VITA.<sup>5/</sup> If STARSYS traffic saturates<sup>6/</sup> the lower part of the band, and if actual operating conditions are such that STARSYS' CDMA system can make use of additional spectrum in the upper part of the band without causing harmful interference to ORBCOMM and VITA, then STARSYS will also operate in the upper part of the band subject to conditions to be negotiated with ORBCOMM and VITA.<sup>7/</sup>

137-138 MHz

Both ORBCOMM and STARSYS would use the 137-138 MHz band for their respective FDMA and CDMA downlink operations. ORBCOMM would use 50 kHz of the band for earth station downlink operations and 270 kHz for satellite-to-user terminal FDMA links.<sup>8/</sup> STARSYS would use 855 kHz of the band for its

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<sup>5/</sup> For example, the operations of one system will not increase the total radio frequency power at the satellite receivers of the other system by a mutually agreed amount, up to 5%; the particular percentage or other limitations selected will depend on measured busy-hour operating conditions.

<sup>6/</sup> See n. 4, supra.

<sup>7/</sup> See n. 5, supra.

<sup>8/</sup> While not addressed in this intraservice sharing agreement, ORBCOMM additionally has proposed to make use of the previously allocated standard frequency and time signal at 400.1 MHz  $\pm$  25 kHz.

satellite-to-STARSYS earth station CDMA downlink transmission. VITA would not use the 137-138 MHz band.

ORBCOMM and STARSYS will share the same downlink frequency band using a combination of angular separation of the satellites, cross polarization, and power flux density limitations. On occasion, a STARSYS or ORBCOMM satellite may create interference into the other system's earth station when the two satellites are close together. Also, the properties of cross polarization of the respective signals may not provide total protection when one of the satellites is close to the horizon due to the antenna pattern phenomenon of appearing elliptical to the respective antennas, but both STARSYS and ORBCOMM are aware of these occasional conflicts and expect them to have only a minor impact on effective operations for either system.

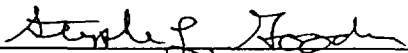
#### 400.15-401 MHz

STARSYS would use 50 kHz of spectrum for FDMA downlink operations from the STARSYS satellites to the STARSYS user terminals. VITA would use 100 kHz of spectrum, separate from STARSYS' operations, for its FDMA downlink transmissions. Specific frequency assignments will be coordinated with appropriate U.S. government agencies.

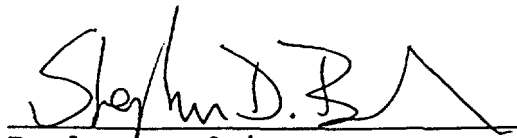
## CONCLUSION

The Applicants believe that the Commission's decision to utilize the alternative resolution mechanism of a Negotiated Rulemaking with a relatively short deadline represents a positive and important step in the direction of streamlining government processes so as to expedite the introduction of important new technologies and services. With this demonstration of a capability for intraservice sharing, the Applicants believe that the Negotiated Rulemaking proceeding can be concluded quickly. Therefore, the Applicants urge the Commission, promptly following the Negotiated Rulemaking, to complete the regulatory actions necessary to inaugurate Non-Voice Non-Geostationary Satellite Services operating below 1 GHz, including release of a notice of proposed rulemaking containing the previously submitted licensing and service rules, adoption of a final allocation order (including the proposed 149.9-150.05 MHz and 399-400.05 MHz bands), and conduct of parallel processing of the applications. These are the necessary and appropriate steps to further the public interest and the Commission's goal of expeditiously making available these important new services to the public.

Respectfully submitted,

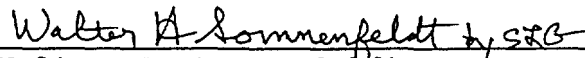
  
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August 7, 1992

CERTIFICATE OF SERVICE

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Before the  
Federal Communications Commission  
Washington, D.C. 20554

ET Docket No. 91-280

In the Matter of

Amendment of Section 2.106 of	RM-7334
the Commission's Rules to	RM-7399
Allocate Spectrum to the Fixed-	RM-7612
Satellite Service and the	
Mobile-Satellite Service for	
Low-Earth Orbit Satellites	

# NOTICE OF PROPOSED RULE MAKING

Adopted: September 26, 1991; Released: October 18, 1991

Comment Date: December 24, 1991

Reply Comment Date: January 23, 1992

By the Commission:

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## I. INTRODUCTION

1. By this *Notice*, we propose to establish a low-Earth orbit (LEO) satellite service and to allocate for its operation the frequency bands 137-138, 148-150.05, 399.9-400.05 and 400.15-401 MHz. We believe it is feasible for LEO systems to utilize these relatively narrow segments of VHF and UHF spectrum to provide to consumers a variety of low cost data messaging and position determination services using small, portable personal radiocommunication units. Operation of these services is made possible by capitalizing on the low power requirements of LEOs and recent advances in launch vehicle and small satellite technology. This action is in response to petitions filed by Orbital Communications Corporation (ORBCOMM), STARSYS Inc. (STARSYS), and Volunteers in Technical Assistance (VITA) and is limited to "small" LEO satellite systems.<sup>1</sup>

## II. BACKGROUND

2. LEO satellites are satellites that are not in geostationary orbit about the earth.<sup>2</sup> LEO satellites orbit the earth at altitudes generally in the order of 1000 to 2000 km (650-1300 miles). LEO satellites have been utilized primarily for military, scientific, and amateur radio communications purposes. The three petitioners propose to establish a new LEO service<sup>3</sup> for public civilian purposes that could offer improved capabilities, such as locating injured or lost hikers in the wilderness, lost or stolen vehicles, and automobile and truck accidents.<sup>4</sup> This service also might be used to locate and communicate with ships at sea.

<sup>1</sup> The Commission is considering LEO proposals as being within one of two distinct categories, "small" or "large." "Small" LEOs would utilize spectrum in the VHF/UHF bands, require relatively small amounts of spectrum (4 MHz or less), and provide non-voice services only, such as data messaging and position determination. "Large" LEOs would utilize spectrum above 1 GHz, require large amounts of spectrum (more than 16 MHz), and include voice communications. Five applicants propose to provide "large" LEO mobile-satellite services in the 1610-1626.5/ 2483.5-2500 MHz bands. Constellation Inc., TRW Inc., and Ellipsat Corporation have filed both petitions and applications. Motorola Corporation and Loral Globalstar Inc. have filed only applications and request a waiver of the Table of Frequency Allocations, 47 C.F.R. Section 2.106. The petitions for rule making and applications are pending. American Mobile Satellite Corporation has also filed a petition for rule making requesting that the Commission allocate the 1515-1525 MHz and 1616.5-1626.5 MHz bands for geostationary mobile-satellite services and an application to provide mobile-satellite services on these frequencies.

<sup>2</sup> A geostationary satellite's circular and direct orbit lies in the plane of the Earth's equator and remains fixed relative to the Earth. The distance to the Earth is approximately 35,785 km (22,235 miles).

<sup>3</sup> In the context of this NPRM, LEO satellite service refers to

the allocations proposed herein for the fixed-satellite service and the mobile-satellite service which are limited to LEO satellites.

<sup>4</sup> ORBCOMM, a subsidiary of Orbital Sciences Corporation, was formed to develop the ORBCOMM LEO satellite system. ORBCOMM states that it has extensive experience in the design and construction of low-Earth orbiting satellites and space launch vehicles. ORBCOMM also has applied to construct a LEO satellite system, see Common Carrier Bureau, File No. 22-DSS-P90(20) (February 28, 1990). On June 3, 1991, ORBCOMM also submitted proposals for service rules in conjunction with its petition, but we are forbearing from addressing such rules at this time. STARSYS is affiliated with North American CLS, which operates the existing Argos LEO system. STARSYS also has filed an application to construct a low-Earth orbit satellite system, see Common Carrier Bureau, File No. 33-DSSP90(24) (May 4, 1990). Volunteers in Technical Assistance (VITA) is a U.S.-based non-profit charitable organization with more than thirty years of experience in providing technical assistance services to individuals and groups in developing countries. It also filed an application to construct a low-Earth orbit satellite system, see Common Carrier Bureau File No. CSS-91-007-(3) (September 20, 1990). All three petitioners have requested parallel processing of their applications with the petitions for rule making. Finally, an application to construct a LEO system below 1 GHz was filed by LEOSAT, Inc. See

3. In its petition, ORBCOMM requests that we amend the Table of Frequency Allocations<sup>5</sup> to allocate 370 kHz in the 137-138 MHz band and 478 kHz in the 148-149.9 MHz band for a low-Earth orbit (LEO) mobile-satellite service (MSS).<sup>6</sup> As an alternative to 148-149.9 MHz, ORBCOMM requests frequencies in the 400.15-403 MHz range. ORBCOMM's proposed system would consist of 20 small satellites placed in circular orbits 970 kilometers above the earth. According to ORBCOMM, economical and spectrum efficient service can be provided due to advances in launch vehicle and small satellite technologies and because of the relatively low power requirements of satellite operations in low-Earth orbit compared with the power requirements of systems using geostationary satellites. It proposes to provide data messaging and position determination services to the United States and its possessions and eventually to provide world-wide coverage.<sup>7</sup>

4. STARSYS also requests establishment of a low-Earth orbit mobile-satellite service that would utilize a total of 2 MHz in the 137-138 and 148-149 MHz bands. It proposes a system that would consist of 24 spacecraft placed in low-Earth orbit at about 1,300 kilometers above the earth. STARSYS proposes to use spread spectrum modulation to provide both two-way data messaging and position determination services similar to the services proposed by ORBCOMM. Alternatively, if spread spectrum is not authorized, STARSYS supports the frequency allocation proposed by ORBCOMM.

5. VITA proposes a non-profit international low-Earth orbit fixed-satellite service that would be used on a humanitarian aid-related basis to provide educational, health, environmental, disaster relief, and other communication services intended to benefit recipients in developing countries. VITA seeks authority to use either a total of 210 kHz in the 137.69-137.75 and 400.15-400.3 MHz bands, or 190 kHz in the 149.81-149.9 and 400.15-400.25 MHz bands. VITA proposes two alternative technical schemes which, it states, are designed to co-exist with the proposals of the commercial applicants.

6. Comments in response to these petitions were received from over 40 parties, including representatives from service organizations, manufacturers, and mobile-satellite providers.<sup>8</sup> The commenters generally support using LEOs for data messaging and position determination services and suggest a number of practical applications for LEO satellite systems.

### III. DISCUSSION

7. Based on the record in this proceeding, we tentatively believe that establishing a small LEO satellite service and allocating frequencies for its operation would be in the public interest. We agree with petitioners that a LEO satellite service can offer a wide variety of services and features at low cost. Also, the allocation of spectrum for a small LEO satellite service would be consistent with and closely track the U.S. proposals for the World Administrative Radio Conference that will convene in Spain in February, 1992 (WARC-92).<sup>9</sup>

8. There are a number of policy issues to be addressed in considering the establishment and the allocation of spectrum for a LEO mobile-satellite service. These include: 1) the need for these services; 2) spectrum requirements; 3) whether it would be possible to accommodate more than one LEO satellite service provider in the same spectrum; and 4) whether spectrum can and should be allocated separately for nonprofit LEO services as proposed by VITA.

#### A. Need for the Service

9. Although certain mobile-satellite services exist that are similar to those proposed by petitioners, the cost of these services provided by geostationary satellites is much higher than that projected by using LEOs. The benefits of using LEOs include the cost of launching LEOs into space, which is 20 times less expensive than launching satellites into geostationary orbit (although the life of a LEO is a little less than half that of a geostationary satellite due to the greater effects of gravity on low-Earth orbit satellites). Portable hand held receivers and antennas for use with LEOs also are expected to be inexpensive, perhaps as low as fifty dollars. When we weigh the advantages and disadvantages, the cost savings of LEOs appear appealing relative to geostationary systems for many data messaging and position determination services.

10. Needs that can be met by a LEO system include data messaging services, position determination, and combinations of these two services. Prominent among these is low-cost message signaling. The LEO service could utilize message signaling to monitor and control activities in the oil exploration and transport industry. Another possible use is research and monitoring, including remote monitoring of various climatic, oceanographic, or environmental areas. Substantial savings in time and money may be achieved by using LEOs for research monitoring at remote sites. Additional non-commercial applications such as educational, health, and disaster relief have been identified as possible data messaging uses for LEO services.

Common Carrier Bureau File No. 12-DSS-P91 (October 12, 1990), proposing to provide messaging and smart car mobile-satellite services. These applications will be processed after this rule making is concluded.

<sup>5</sup> 47 C.F.R. Section 2.106.

<sup>6</sup> ORBCOMM also proposes to use the 400.075 to 400.125 MHz band to transmit time information and a standard frequency. This use accords with existing allocations, and therefore is not a subject of this Notice.

<sup>7</sup> ORBCOMM, STARSYS, and VITA each have applied for a pioneer's preference in this proceeding. See *Report and Order*, GEN Docket 90-217, 6 FCC Rcd 3488 (released May 13, 1991), petitions for reconsideration pending, which established procedures for providing a licensing preference to applicants that propose an allocation for a new service. See also, *Filing Require-*

*ments for Pioneer's Preference*, Public Notice issued June 13, 1991. Although our pioneer's preference rules provide for addressing these requests concomitantly with this Notice, the issues in this proceeding were pending before the pioneer's preference rules became effective on July 30, 1991. Because of our desire to adequately address comments on the preference requests we will separately consider the preference claims of the petitioners in a *Further Notice* in the near future.

<sup>8</sup> See Appendix A for a list of parties that provided comments or reply comments in this proceeding.

<sup>9</sup> See *Report and Order*, GEN Docket 89-554, 6 FCC Rcd 3900 (released June 20, 1991) at paragraphs 43-49. The Commission recommended that the United States propose an international allocation of 137-138/148-149.9/400.15-401.0 MHz for LEOs on a primary shared basis at WARC-1992.

11. The demand for position determination services includes industrial applications as well as non-profit and personal safety uses. Applications referred to in the petitions and comments include tracking and monitoring the location of cars, trucks, and ships. LEOs would permit a small transmitter to be activated to locate a stolen vehicle, an automobile in an accident, a ship lost at sea, or a cargo ship or train in transit. In similar fashion, hikers in the wilderness might use inexpensive transmitters that would permit monitoring and rescue efforts in cases of unforeseen difficulty.

12. Some applications such as search and rescue operations, would utilize a combination of the data messaging and position determining capabilities of LEOs. For example, a lost hiker could initiate notification of his predicament using the data messaging capability and could be located using the position determining function. Current communications equipment used by hikers consists of fixed channel VHF radios operating on public service radio frequencies that are insufficient because line of sight transmissions are difficult to maintain and communications are often lost due to dead zones caused by terrain. Communications through LEO satellite systems would not encounter these problems.<sup>10</sup>

13. Based on the information provided in the petitions and the responses thereto, we believe that there is significant unmet need for low-cost data messaging and position determination services that could be met by a LEO satellite source. The vast majority of comments received in response to these petitions indicate that a LEO service as described by the petitioners is desirable and viable. We believe that this service can be integrated into the existing market and help fill the large demand for satellite communications services. This conclusion is further buttressed by the interest expressed by the petitioners, each of which is willing to develop a LEO system and provide service, and by the potential users and others that submitted comments.

14. Accordingly, we believe a proposal to establish a LEO satellite service is warranted. This proposal tracks our recommendations for WARC-92. We request comment on the extent to which the proposed LEO services could be met through the facilities of other existing services. To the extent feasible, commenters should specifically address demand for specific services, projected costs for those services, and the benefits and costs of providing these services by LEOs compared with geostationary satellites or other means.

#### B. Spectrum Issues

15. We tentatively conclude that up to 4 MHz of spectrum is needed in the VHF/UHF bands to accommodate a domestic satellite service utilizing LEOs and propose to allocate 137-138, 148-150.05, 399.9-400.05, and 400.15-401 MHz for this purpose. Although each petitioner's proposal differs in some respects, each argues that spectrum in the VHF and UHF bands is the most appropriate for LEOs due to suitable propagation characteristics, the low cost of equipment, and the feasibility of sharing these

frequencies without displacing current users. ORBCOMM states its requirements for approximately 900 kHz using a frequency division multiple access (FDMA) modulation scheme. STARSYS proposes to use 2 MHz, but would utilize spread spectrum modulation that could accommodate competitive providers on the same frequencies. However, STARSYS alternatively requests the same spectrum as ORBCOMM if its spread spectrum proposal is rejected. VITA requests only about 200 kHz to provide "store and forward" communications with locations mostly in Africa and Asia, and could use either modulation scheme. The only alternative to these VHF/UHF bands would be to use spectrum above 1 GHz. However, petitioners argue that using spectrum above 1 GHz is not desirable due to the propagation characteristics of these higher frequencies and associated higher equipment cost.

16. *The 137-138 MHz Band.* We have examined the 137-138 MHz band to determine its suitability for LEO communications and the potential impact on existing users. During preparation of our WARC-92 recommendations we noted concerns regarding use of these frequencies for LEOs. The band currently is allocated worldwide on a primary basis to the Space Operation, Meteorological Satellite, and Space Research services (space-to-Earth).<sup>11</sup> Although we believe sharing with these other geostationary and non-geostationary satellites on a continuous global basis may be possible, the mechanics for that sharing have not been fully developed. Therefore, we request detailed technical analysis of the design aspects of each proposed LEO system relevant to its potential to cause interference to or receive interference from the existing users in the 137-138 MHz band.

17. We seek comment on our proposal to allocate the 137-138 MHz band to the mobile-satellite and fixed-satellite service for space-to-Earth communications by small low-Earth orbit operations. In this regard we note that LEOs use lower power than geostationary satellites and consequently are less likely to cause interference to existing government operations. We additionally propose that until January 1, 2000, use of this band for LEOs be secondary to government operations within the following frequency ranges: 137.333-137.367, 137.485-137.515, 137.605-137.635 and 137.753-137.787 MHz. Finally, we propose to include new footnotes in the Table of Frequency Allocations that limit the mobile-satellite and fixed-satellite (space-to-Earth) service at these frequencies to LEOs on a secondary basis to the meteorological-satellite (space-to-Earth) services operating at 137.025-137.175 and 137.825-137.975 MHz. The purpose of these conditions is to protect operations currently using these frequencies, and result from discussions with the National Telecommunications and Information Administration (NTIA) and other federal agencies.

18. *The 148-150.05 MHz Band.* As with the 137-138 MHz band, we solicit comment on the practicality of LEOs sharing the 148-149.9 MHz band. In addition to

<sup>10</sup> This NPRM proposes to allocate spectrum to generic LEO services that could include public safety applications (fixed-satellite and mobile-satellite) but does not propose to allocate spectrum exclusively for safety services.

<sup>11</sup> There currently are 27 non-geostationary satellites and 16

geostationary satellites identified as operating in this band by ITU Publication List VIIA of Stations in the Space Radiocommunications Services and in the Radio Astronomy Service (March 1990). These satellites are used for space operation, meteorological information gathering and space research.



satellite systems.<sup>12</sup> the 148-149.9 MHz band also is used by both government and non-government fixed and mobile services on a primary basis. The petitions do not adequately address the constraints required to share this band for Earth-to-space links on a co-primary basis with these users. As a result of discussions with NTIA and other federal agencies, we propose the following guidelines to protect existing users from interference. First, we propose to limit use of 148-149.9 MHz in the mobile-satellite and fixed-satellite service (Earth-to-space) to LEOs and to subject this use to the following conditions: 1) LEO operation does not constrain operation of the fixed and mobile services; 2) LEOs be designed to accept all signals into the satellite from the fixed and mobile systems; 3) LEO earth stations either avoid channels being used by the fixed and mobile services, or limit their spectral power density; 4) LEO transmissions be short bursts of 150 milliseconds or less and employ a low duty cycle;<sup>13</sup> and 5) LEOs be limited to nonvoice services. We seek comment on the benefits of avoiding channels being used compared with limiting spectral power density; and on what spectral power density levels would provide the required protection. More generally, we seek comment on the feasibility of LEOs complying with these technical requirements, and on additional or alternative requirements that might be necessary to prevent interference with other users.

19. In addition, we note that the Department of Defense (DOD) uses 149.9-150.05 MHz for the radionavigation satellite "TRANSIT-SAT". Since "TRANSIT-SAT" is expected to cease operation in December, 1996, we propose that 149.9-150.05 MHz be allocated for LEOs on a primary basis after January 1, 1997.

20. *The 399.9-401 MHz Band.* We note that operation on the 399.9-400.05 MHz band by the "TRANSIT-SAT" radionavigation satellite, is expected to cease in December, 1996, *supra*. Therefore, this band will also be available after that time and we seek comment on its possible use by LEOs. We also seek comment on use of 400.15-401 MHz band by LEOs. Such use closely tracks our recommendations for WARC-92.<sup>14</sup> Although ORBCOMM also requests frequencies at 401-403 MHz, we believe that 399.9-400.05 and 400.15-401 MHz, in conjunction with the bands discussed above, will provide spectrum sufficient to accommodate one or more LEO licensees.<sup>15</sup>

21. In conclusion, we are proposing to allocate 137-138 MHz, 148-150.05 MHz, 399.9-400.05 MHz and 400.15-401 MHz for LEOs, subject to the conditions specified above. We are proposing more spectrum than has been requested by any one of the petitioners. This is due to the availability of bands now used by the "TRANSIT-SAT"; to our desire to accommodate competing LEO satellite systems; and to account for the restrictions on sharing in some of the proposed bands. This proposal for a domestic allocation

for LEOs is also slightly broader than our WARC-92 recommendations because we learned only recently that the "TRANSIT-SAT" frequencies will be available.

### C. Additional Matters

22. Based on discussions with various federal agencies that operate in these bands, there remain several questions with regard to spectrum sharing between LEOs and existing services. We seek comment on the specific constraints that may be necessary for LEOs to share these bands. Specifically, we seek comment on allocating this spectrum for LEOs, the relative advantages and disadvantages of using FDMA versus spread spectrum, the interference potential associated with these proposals, and other spectrum alternatives that might be suitable for provision of the above-described LEO satellite services. We also seek comment on additional coordination and sharing requirements that might be necessary for these LEO services to use the proposed channels.

23. Unlike STARSYS and ORBCOMM, VITA proposes a fixed, rather than mobile, satellite service. It appears that its proposal for a limited data messaging system is compatible with either of the other two, and because of its limited nature, we believe it can be accommodated. We tentatively conclude that providing spectrum for non-commercial, humanitarian operations as proposed by VITA is desirable and would be in the public interest. We seek comment on accommodating VITA's request for a limited fixed satellite service (FSS) allocation, and on whether its technical proposal can be accommodated by each of the other proposed commercial systems. We specifically are interested in any effect upon the others' capacity that would result from operation of the parallel system proposed by VITA.

24. We also request comment on whether a commercial LEO licensee is likely to offer LEO services to non-profit organizations at lower cost than a non-commercial LEO licensee could independently develop its own system. Therefore, in conjunction with comments on VITA's proposal and its likely effect on any commercial system, we also seek comment on whether a separate allocation for non-commercial LEOs should be established or whether a general LEO allocation is sufficient to meet the needs of both commercial and non-commercial users.

25. We intend to provide for multiple operators of LEO systems. A primary issue in this regard is the type of modulation that will be utilized. STARSYS claims that multiple service providers would be possible within the same spectrum if its proposed spread spectrum concept is adopted. ORBCOMM disputes the claims made by STARSYS and argues that the proposed STARSYS system will be unworkable. ORBCOMM proposes to utilize FDMA modulation on a total of 848 kHz, and states that it has no objections to other LEO satellite systems if they do not cause interference to its system.<sup>16</sup> However, neither ORBCOMM nor any other party has submitted information

<sup>12</sup> In the 148-149.9 MHz band, ITU Publication List VIIA identifies 30 non-geostationary satellites and 17 geostationary satellites.

<sup>13</sup> We seek comments on the specific duty cycle that should be required if this condition is adopted in the final rule.

<sup>14</sup> See note 9, *supra*.

<sup>15</sup> With respect to the proposed allocation of 399.9-400.05 and 400.15-401.0 MHz, there is no intention of using these allocations

in a bi-directional mode of operation. Both direction indicators are listed in Appendix B to provide the Commission the flexibility necessary to process the applications, which propose to use a particular allocation either as an uplink or a downlink to be compatible with other systems.

<sup>16</sup> See ORBCOMM Reply Comments to its petition, RM-7334 (May 22, 1990).

tion that addresses how multiple systems could best be accommodated in the same spectrum. Therefore, at this time we are not prepared to take a position as to whether a spread spectrum system using the full 137-138/148-149 MHz band is more desirable than a system using FDMA in a portion of the proposed bands. However, we request comment on the competitive advantages and disadvantages of requiring spread spectrum or FDMA modulation for this service and on any other possible modulation schemes or technology that would assist us in providing for a competitive LEO service in the spectrum proposed.

#### IV. CONCLUSION

26. In response to the three petitions for rule making discussed above, we propose to establish a mobile-satellite/fixed-satellite service limited to low-Earth orbit satellites and to allocate for this service 137-138 MHz, 148-150.05 MHz, 399.9-400.05, and 400.15-401 MHz. Based upon the perceived need in the record for data messaging and position determination services and upon the apparent willingness of these petitioners to invest in LEO technology, we tentatively conclude that there is a viable market for the services and that providing for these needs would be in the public interest. We expect that this service would make available to the American public additional communication services at significantly less cost than currently available. We invite comment on these assessments, on the issues specified above, and on any other issues relevant to the allocation of spectrum for this purpose.

#### V. INITIAL REGULATORY FLEXIBILITY ANALYSIS

27. Pursuant to the Regulatory Flexibility Act of 1980, the Commission finds as follows:

##### A. Reason for Action

This action is being initiated to provide an allocation for a low-Earth orbit satellite service. We believe that there is a need for additional spectrum for mobile and fixed satellite services for data messaging and position determination services and that LEOs offer a cost effective means to accommodate this need. We also intend to protect existing users if spectrum is allocated for an LEO satellite service.

##### B. Objective

The objective of this proposal is to promote efficiency in the allocation of spectrum for meeting the public's requirements for low-cost data messaging and positioning services. This objective can be met by establishing the low-Earth orbit satellite service. Providing for the development of LEO technology in the United States also will promote the provision of these satellite services by U.S. firms.

##### C. Legal Basis

The proposed action is authorized by Sections 4(i), 303(c), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 303(c), 303(f), 303(g), and 303(r). These provisions authorize the Commission to make such rules and regulations as may be necessary to encourage more effective use of radio as is in the public interest.

##### D. Description, Potential Impact, and Number of Small Entities Affected

This proposal may provide new marketing opportunities for radio manufacturers, some of which may be small businesses. Because this proposal concerns only the allocation of spectrum, and not the licensing of systems or stations, we are unable to quantify other potential effects on small entities. We invite specific comments on this point by interested parties.

##### E. Reporting, Record Keeping and other Compliance Requirements

None.

##### F. Federal Rules which Overlap, Duplicate or Conflict with this Rule

None.

##### G. Significant Alternatives

If promulgated, this proposal will allow mobile-satellite and fixed-satellite services to share spectrum, on a co-primary basis, with the government fixed and mobile and the space operations services. We are proposing only a spectrum allocation at this time. Specific technical standards, rules, and regulations will be determined in future proceedings.

#### VI. PAPERWORK REDUCTION ACT

28. The proposal contained herein has been analyzed with respect to the Paperwork Reduction Act of 1980 and found to contain no new or modified form, information collection and/or record keeping, labeling, disclosure, or record retention requirements, and will not increase or decrease burden hours imposed on the public.

#### VII. PROCEDURAL INFORMATION

29. For purposes of this non-restricted notice and comment rule making proceeding, members of the public are advised that *ex parte* presentations are permitted except during the Sunshine Agenda period. See generally 47 C.F.R. Section 1.1206(a). The Sunshine Agenda period is the period of time which commences with the release of a public notice that a matter has been placed on the Sunshine Agenda and terminates when the Commission (1) releases the text of a decision or order in the matter; (2) issues a public notice stating that the matter has been deleted from the Sunshine Agenda; or (3) issues a public notice stating that the matter has been returned to the staff for further consideration, whichever occurs first. 47 C.F.R. Section 1.1202(f). During the Sunshine Agenda period, no presentations, *ex parte* or otherwise, are permitted unless specifically requested by Commission or staff for the clarification or adduction of evidence or the resolution of issues in the proceeding. 47 C.F.R. Section 1.1203.

30. In general, an *ex parte* presentation is any presentation directed to the merits or outcome of the proceeding made to decision-making personnel which (1) if written, is not served on the parties to the proceeding, or (2), if oral, is made without advance notice to the parties to the proceeding and without opportunity for them to be present. 47 C.F.R. Section 1.1202(b). Any person who makes or submits a written *ex parte* presentation shall

provide on the same day it is submitted two copies of same under separate cover to the Commission's Secretary for inclusion in the public record. The presentation (as well as any transmittal letter) must clearly indicate on its face the docket number of the particular proceeding and the fact that an original and one copy of it have been submitted to the Secretary, and must be labeled or captioned as an *ex parte* presentation, 47 C.F.R. Section 1.1206.

31. Any person who in making an oral *ex parte* presentation presents data or arguments not already reflected in that person's written comments, memoranda, or other previous filings in that proceeding shall provide on the day of the oral presentation an original and one copy of a written memorandum to the Secretary (with a copy to the Commissioner or staff member involved) which summarizes the data and arguments. The memorandum (as well as any transmittal letter) must clearly indicate on its face the docket number of the particular proceeding and the fact that an original and one copy of it have been submitted to the Secretary, and must be labeled or captioned as an *ex parte* presentation, 47 C.F.R. Section 1.1206.

32. This action is taken pursuant to Sections 4(i), 303(c), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 303(c), 303(f), 303(g), and 303(r).

33. Pursuant to applicable procedures set forth at 47 C.F.R. Sections 1.415 and 1.419, of the Commission's Rules, interested parties may file comments on or before **December 24, 1991**, and reply comments on or before **January 23, 1992**. All relevant and timely comments will be considered by the Commission before final action is taken in this proceeding. To file formally in this proceeding, participants must file an original and four copies of all comments, reply comments, and supporting comments. If participants want each Commissioner to receive a personal copy of their comments, an original plus nine copies must be filed. Comments and reply comments should be sent to Office of the Secretary, Federal Communications Commission, Washington, D.C. 20554. Comments and reply comments will be available for public inspection during regular business hours in the Dockets Reference Room (Room 239) of the Federal Communications Commission, 1919 M Street, N.W., Washington, D.C. 20554.

34. For further information concerning this rule making contact Mr. Raymond LaForge at (202) 653-8117, Office of Engineering and Technology, Federal Communications Commission, Washington, D.C. 20554.

#### FEDERAL COMMUNICATIONS COMMISSION

Donna R. Searcy  
Secretary

#### APPENDIX A

##### Parties Filing Comments to the ORBCOMM Petition for Rule Making

AeroAstro Corporation  
American Mobile Satellite Corporation  
Ford Motor Company  
Geostar Corporation  
L-Tronics  
Maxon  
Mitsubishi  
NEC America, Inc.  
North American CLS  
OTC Limited  
Portland Mountain Rescue  
Public Service Satellite Consortium  
SCI Technology, Inc.  
Sierra Madre Search and Rescue Team  
Southern Marine Research  
The Virginia Center for Innovative Technology  
Volunteers in Technical Assistance, Inc.

##### Parties Filing Reply Comments to the ORBCOMM Petition for Rule Making

ORBCOMM  
STARSYS

##### Parties Filing Comments to the STARSYS Petition for Rule Making

Geostar Corporation  
Houston Data Transmission Company  
MicroSat Launch Systems, Inc.  
Natural Resources Consultants, Inc.  
ORBCOMM  
Polar Science Center, Applied Physics Laboratory,  
College of Ocean and Fishery Sciences, University  
of Washington  
R. Dale Pillsbury  
Southwest Research Institute  
The Inter-American Tropical Tuna Commission  
The Volunteer Observing Ship Program, Scripps Institution of Oceanography, University of California,  
San Diego

##### Parties Filing Reply Comments to the STARSYS Petition for Rule Making

ORBCOMM  
STARSYS

**Parties Filing Comments to the VITA Petition for Rule Making**

Center for Information Systems and Research  
Clearinghouse on Development Communication  
Foster Parents Plan International  
Helen Keller International  
International Voluntary Services, Inc.  
New TransCentury Foundation, Inc.  
ORBCOMM  
National Association of Partners of the Americas  
Private Agencies Collaborating Together  
Public Service Satellite Consortium  
SATELLIFE  
Save the Children  
United Nations Development Programme  
The U.S. Agency for International Development,  
Center for Development Information and Evaluation  
The U.S. Agency for International Development,  
Office of the Science Advisor  
The University of Massachusetts, Renewable Energy  
Research Laboratory  
YMCA of the USA, International Division

d. Add mobile-satellite and fixed-satellite services primary allocations to columns 4 and 5 for the 137-138 MHz, 148.0-149.9 MHz, 149.9-150.05 MHz, 399.9-400.05 MHz and 400.15-401.0 MHz bands.

e. Add a new footnote US321 to columns 4 and 5 of the band 399.9-400.05 MHz.

f. Add a new footnote US322 to columns 4 and 5 of the band 400.15-401 MHz.

**Parties Filing Reply Comments to the VITA Petition**

Volunteers in Technical Assistance, Inc.

**APPENDIX B****RULE CHANGE**

I. Part 2 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

**PART 2 -- FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS**

1. The authority citation in Part 2 continues to read:

**AUTHORITY:** Sec. 4, 302, 303, and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154, 302, 303, and 307, unless otherwise noted.

2. Section 2.106, the Table of Frequency Allocations is amended as follows:

- a. Add a new Footnote US318 to columns 4 and 5 of the band 137.0-138.0 MHz.
- b. Add a new Footnote US 319 to columns 4 and 5 of the band 149.9-150.05 MHz.
- c. Add a new Footnote US320 to columns 4 and 5 of the band 148.0-149.9 MHz.

## Section 2.106 Table of Frequency Allocations

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International Table			United States Table		FCC use designators	
Region 1 Allocation MHz	Region 2 Allocation MHz	Region 3 Allocation MHz	Government Allocation MHz	Non-Government Allocation MHz	Rule Part (s)	Special-Use Frequencies
(1)	(2)	(3)	(4)	(5)	(6)	(7)

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	148.0-149.9 FIXED. MOBILE. (Earth-to-space)		148.0-149.9 FIXED. MOBILE. MOBILE-SATELLITE (Earth-to-space). FIXED-SATELLITE (Earth-to-space).	148.0-149.9 MOBILE-SATELLITE (Earth-to-space). FIXED-SATELLITE	SATELLITE COMMUNICATION (25).	
608	608		608 US10 US320 G30	608 US10 US320		
149.9-150.05	RADIONAVIGATION- SATELLITE.		149.9-150.05 RADIONAVIGATION- SATELLITE. MOBILE-SATELLITE (Earth-to-space). FIXED-SATELLITE (Earth-to-space).	149.9-150.05 RADIONAVIGATION SATELLITE. MOBILE-SATELLITE (Earth-to-space). FIXED-SATELLITE (Earth-to-space).		
	609 609A		609A US319	609A US319		

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International Table			United States Table		FCC use designators	
Region 1 Allocation MHz	Region 2 Allocation MHz	Region 3 Allocation MHz	Government Allocation MHz	Non-Government Allocation MHz	Rule Part (s)	Special-Use Frequencies
(1)	(2)	(3)	(4)	(5)	(6)	(7)
*		*	*		*	*
399.9-400.05	RADIONAVIGATION- SATELLITE.		399.9-400.05 RADIONAVIGATION- SATELLITE. MOBILE-SATELLITE (space-to-Earth) (Earth-to-space). FIXED-SATELLITE (space-to-Earth) (Earth-to-space).	399.9-400.05 RADIONAVIGATION- SATELLITE. MOBILE-SATELLITE (space-to-Earth) (Earth-to-space) FIXED-SATELLITE (space-to-Earth) (Earth-to-space).		
	609 645B		645B US321	645B US321		
*		*	*		*	*

International Table			United States Table		FCC use designators	
Region 1 Allocation MHz	Region 2 Allocation MHz	Region 3 Allocation MHz	Government Allocation MHz	Non-Government Allocation MHz	Rule Part (s)	Special-Use Frequencies
(1)	(2)	(3)	(4)	(5)	(6)	(7)

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400.15-401.0	METEOROLOGICAL AIDS. METEOROLOGICAL- SATELLITE (space-to-Earth) SPACE RESEARCH (space-to-Earth) Space Operation (space-to-Earth)		400.15-401.0 METEOROLOGICAL AIDS (radiosonde) METEOROLOGICAL- SATELLITE (space-to-Earth) Space Operation (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) (Earth-to-space) FIXED-SATELLITE (space-to-Earth) (Earth-to-space)	400.15-401.0 METEOROLOGICAL AIDS (radiosonde) SPACE RESEARCH (space-to-Earth) Space Operation (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) (Earth-to-space) FIXED-SATELLITE (space-to-Earth) (Earth-to-space)	SATELLITE COMMUNICATION (25).	
	647		US70 US322	US70 US322		

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## US FOOTNOTES FOR ILLUSTRATIONS

**US318** The mobile-satellite (space-to-Earth) and the fixed-satellite (space-to-Earth) services in the 137-138 MHz band are limited to low-Earth orbit (LEO) satellite operations. Until January 1, 2000, use of this band for LEO satellites will be secondary to the U.S. government operations within the following frequency ranges: 137.333-137.367, 137.485-137.515, 137.605-137.635 and 137.753-137.787 MHz. The mobile-satellite (space-to-Earth) and the fixed-satellite (space-to-Earth) services at these frequencies are on a secondary basis to the meteorological-satellite (space-to-Earth) service operating at 137.025-137.175 and 137.825-137.975 MHz.

**US319** The 149.9-150.05 MHz band may be used for low-Earth orbit mobile-satellite (Earth-to-space) and fixed-satellite (Earth-to-space) services after December 31, 1996.

**US320** Use of the 148-149.9 MHz band for mobile-satellite (Earth-to-space) and fixed-satellite (Earth-to-space) services is limited to low-Earth orbit (LEO) satellite systems and subject to the following conditions: 1) LEO operations shall not constrain operation of the fixed and mobile services; 2) LEOs shall be designed to accept all signals into the satellite from the fixed and mobile systems; 3) to preclude interference to terrestrial stations operating in accordance with the Frequency Allocation Table, the LEO earth stations shall avoid channels being used by the fixed and mobile services, or limit their spectral power density; 4) the transmissions will be short bursts of 150 milliseconds or less and have a low duty cycle; and 5) the LEOs shall be limited to non-voice services.

**US321** The 399.9-400.05 MHz band may be used for low-Earth orbit mobile-satellite (Earth-to-space and space-to-Earth) and fixed-satellite (Earth-to-space and space-to-Earth) services after December 31, 1996.

**US322** The mobile-satellite service (space-to-Earth and Earth-to-space) and the fixed-satellite (space-to-Earth and Earth-to-space) services in the 400.15-401 MHz band are limited to low-Earth orbit (LEO) operations.